UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

MEMORANDUM November 14, 2000

SUBJECT: Revised Tier 2 EEC's for Diazinon

TO: Danette Drew,
Health Effects Division

FROM: R. David Jones, Ph.D., Senior Agronomist
Enviromental Risk Branch 4
Environmental Fate and Effects Division

THROUGH: Elizabeth Behl, Branch Chief
Environmental Risk Branch 4
Environmental Fate and Effects Division

This report describes the revised Tier II estimated environmental concentrations (EEC's) for diazinon, O,O-diethyl-O-(2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate (Figure 1) as applied to a variety of crops. Nineteen of these crops were previously assessed using modeling. (See Table 1.) The purpose of this analysis is to make the drinking water assessments using the index reservoir and to update the chemical input parameters so that they are consistent with current guidance. Note that Tier 1 EEC's have not been calculated for diazinon except for pineapples.

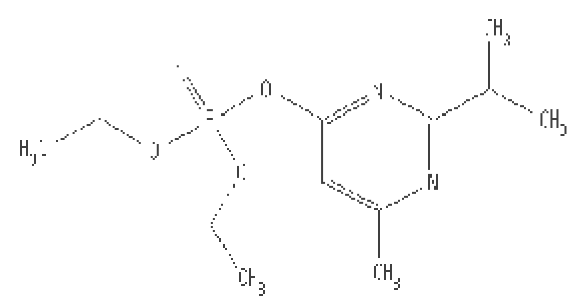

Figure 1. Molecular structure of diazinon.

Table 1. Crops used in previous diazinon surface water assessments.
Almonds
Walnuts
Citrus
Cucumbers
Strawberries
Sweet Corn
Peaches
Pineapples
Sugarcane
Potatoes
Blueberries
Cotton
Soybeans
Tobacco
Apples
Grapes
Corn

Simulations were run for three crops in this assessment, oranges, peaches, and walnuts. Oranges were used to represent all citrus crops. Walnuts were chosen as it has the highest seasonal application rate and considerable use. Peaches and citrus were chosen as they are grown in the Southeastern United States where weather and soil conditions are prone to generate pesticide runoff. Simulations were done at both the maximum application rate and for a typical practice. Typical practice was based on the mean application rate and number of applications for each crop. It is worth noting that, while the use has not been canceled, the diazinon registrants have indicated that they do not intend to continue supporting the citrus use.

These EEC's presented here represent a Tier II level assessment. They were estimated using a single site which represents a high exposure scenario for the use of the pesticide on a particular crop or non-crop use site. These sights are chosen by best professional judgement to represent a site that is expected to have higher pesticide concentrations than 90% of the sites where the crop is grown. The weather and agricultural practice are simulated at the site over multiple (in this case, 34 or 36) years so that the probability of an EEC occurring at that site can be estimated.

This assessment supercedes a previous assessment that used the standard pond scenario (Matzner, 1999) that also considered a wider variety of crops (Table 1). These EEC's are still valid for ecological risk assessment. The following changes have been made from the previous assessment.

Index Reservoir. The index reservoir which is now used for drinking water assessments was not yet implemented when the previous assessment was completed. This assessment estimates drinking water concentrations based on the Index Reservoir rather than the standard pond. The index reservoir used for the simulation on walnuts and peaches differ from the standard index reservoir in that the temperature profile in the reservoir has been modified to reflect the mean monthly air temperature for two of the three locations (walnuts and peaches) rather than the standard temperature profile used with the index reservoir. The temperature profiles used are in Appendix D. The standard temperature profile was used with the citrus simulation as the local temperature profile is not currently available.

Hydrolysis. In the previous assessment, the rate constants for hydrolysis at pH 5, 7 and 9 were used as input for the KAH, KNH and KBH parameters in EXAMS. In this assessment they have been replaced with the process specific rate constants k_{acid}, k_n, and k_{alk}.

Soil Metabolism. In the previous assessment the mean aerobic soil metabolism value was used as the input value for DSRATE and DWRATE in PRZM. In this assessment, the upper 90% confidence bound on the mean was used to be consistence with current guidance. (Parker *et al., 1997*)

Aquatic Metabolism. In the previous assessment, the aerobic soil metabolism rate was used as a surrogate value for the water column metabolism rate, KBACW. As no aerobic aquatic metabolism data was available, twice the value used for DWRATE in PRZM was used in accordance with current guidance. An anaerobic soil metabolism value was available and was used in the previous assessment, however, it has been determined to be unsuitable for use in generating model input parameters as glucose was added to the system during incubation. Consequently, the value for KBACS was generated from the DWRATE input parameter for the subsurface horizons in PRZM by dividing it by two.

Photolysis. Photolysis was not considered in previous modeling. Both aqueous and soil photolysis have been considered in this assessment.

Foliar Degradation Constants. Data on foliar degradation rates was obtained to estimate the dissipation of diazinon from plant surfaces. These values have been used to estimate the foliar degradation rate for this assessment.

Soil Water Partition Coefficients. The soil-water partitioning data has been re-analyzed and a value for K_{oc} estimated at758 L kg^{-1}. This value was used in place of the values used in the previous assessment.

Typical Use Patterns. Typical use patterns were not simulated for the previous assessment. Typical use patterns have been included for all three scenarios modeled. A description of how these practices were simulated is described in the body of this document.

Table 1. Tier 2 upper tenth percentile EEC's for drinking water from diazinon applied to walnuts.

Product	Maximum	Annual Mean	Overall Mean
Maximum Label Rate			
citrus*	540 µg·L^{-1}	58.9 µg·L^{-1}	30.1 µg·L^{-1}
peaches	70.1 µg·L^{-1}	9.4 µg·L^{-1}	6.9 µg·L^{-1}
walnuts	41.5 µg·L^{-1}	10.4 µg·L^{-1}	9.7 µg·L^{-1}
Typical Use			
citrus*	85.0 µg·L^{-1}	10.6 µg·L^{-1}	4.1 µg·L^{-1}
peaches	40.5 µg·L^{-1}	5.4 µg·L^{-1}	3.0 µg·L^{-1}
walnuts	25.7 µg·L^{-1}	4.8 µg·L^{-1}	4.0 µg·L^{-1}

*Oranges in Florida were used to represent the citrus use.

The estimated environmental concentrations from this assessment are listed in Table 1. The maximum label rate values represent the upper bound estimates on what could occur in water bodies that support drinking water facilities. The maximum value is intended for acute risk assessment, the annual mean is for chronic non-cancer risk assessment, and the overall mean for use in cancer risk assessment. These values represent the values that would occur or be exceeded once every ten years at a site that is more vulnerable that 90% where the pesticide is used on a particular crop. The overall mean is the mean of the whole chemograph over whole simulation. The typical values represent what could occur at the same site with typical agricultural practices with the same return frequencies as the maximum application values. These values are for comparison purposes and to provide additional information to risk managers in the regulatory process. All the values in Table 1 have been adjusted by the default PCA of 0.87 in accordance with current guidance (U.S. Environmental Protection Agency, 2000b).

It is of particular note that these estimates do not consider any degradates. In particular, diazoxon, which during oxidative (chlorination or ozonation) drinking water treatment (Aizawa and Magara, 1992, Magara et al, *1992, Ohashi* et al., *1994) , is not considered in this assessment. It has also been found in some ambient surface waters in California (Domagalski, 1996) This is a substantial uncertainty in this assessment and may result in this assessment being an underestimate of the risk in some cases.*

Models Used

The EEC's were calculated using two models: PRZM version 3.12 (Carsel *et al*., 1997), dated May 7, 1998 to simulate the transport of the pesticide off the field, and EXAMS 2.97.5 (Burns, 1997), dated June 13, 1997, to simulate the fate of the chemicals in the water body. The output from EXAMS was summarized using the Table20 Post-processor, dated March 2, 1998.

Scenarios

Three scenarios were used to represent high exposure sites for diazinon use on agricultural crops. These sites represent 172.8 hectare watersheds draining into a 5.26 hectare lake, 2.74 m deep. This watershed, commonly known as the index reservoir, was developed to represent a watershed that was more vulnerable than most watersheds to pesticide contamination. It represents a real drinking water reservoir in Illinois, Shipman City Lake. The geometry for the index reservoir is used with local weather and soils to represent vulnerable watersheds for different crops in different regions of the country. A detailed description of the index reservoir found in the guidance for using the index reservoir. (U. S. Environmental Protection Agency, 2000). Descriptions of the three scenarios is provided below.

An orange grove in Osceola County Florida was used to represent the citrus use. It has a Adamsville sand soil, a hyperthermic, uncoated Aquic Quartzipsamment USDA (Natural Resources Conservation Service, 1998). The Adamsville sand is a Hydrologic Group C soil and SCS curve numbers were generated based on this grouping and the plant cover as above. In 1997, the 17, 113 acres of citrus and 14, 642 acres of oranges were grown in Osceola County (USDA National Agricultural Statistics Service, 1999). The weather data is from weather station W12839 in Miami, Florida and is used to represent the weather for MLRA 156a in the PIRANHA shell (Allen *et al*, 1992). The PRZM 2 parameters describing this scenario are in Appendix A.

The peach orchard is in Peach County, Georgia. This county is in Major Land Resource Area P133a, the Southern Coastal Plain. It has a Boswell sandy loam soil, a fine, mixed, thermic Vertic Paleudalf, in MLRA P133A (Natural Resources Conservation Service, 1998). The Boswell soil is hydrologic group C soil and SCS curve numbers were generated based on this grouping and the plant cover as above. 9024 acres of peaches were grown in Peach County in 1997 which was the most of any county in Georgia (USDA National Agricultural Statistics Service, 1999). The weather data is from weather station W03820 in Augusta, Georgia. The weather data file is also part of the PIRANHA shell and is used to represent the weather for MLRA 137 (Allen *et al*, 1992). This weather data was used rather than the data for MLRA 133A (Montgomery, Alabama) as is was thought to be more appropriate for this particular location. The PRZM 2 parameters describing this scenario are in Appendix B.

The walnut scenario was in Kern County, California which is in Major Land Resource Area C17, the Sacramento and San Joaquin Valley. The soil is a Kimberlina sandy loam, a coarse-loamy, mixed, superactive, calcareous, thermic Typic Torriorthents (Natural Resources Conservation Service, 1998). The Kimberlina sandy loam is in Hydrologic Group B and SCS curve numbers were generated based on this grouping and the plant cover as above. Data for this soil was taken from the PIC data base. One thousand eight hundred and seventy three acres of walnuts were grown in Kern county in 1997.Weather data was taken from weather station W23155 in Bakersfield, California and is part of the PIRANHA shell used to represent MLRA C17 (Allen *et al*., 1992) . This weather data was also used to generate the temperature profile in the reservoir. The PRZM parameters for this site are in Appendix C.

In all cases, the water body used with each scenario was the index reservoir. The description of the development, parameters and use of the index reservoir are provided in the guidance document (U. S. EPA, 2000a). As mentioned above, the reservoirs used for the walnut and peach simulations have been modified to include local temperature profiles. The temperature profiles for these two scenarios are in Appendix D.

Chemistry

Diazinon is an organophosphate insecticide used on a wide variety of food crops. It also has a substantial amount of non-crop uses, particularly in residential settings. Diazinon environmental fate data used for generating model parameters are listed in Table 3, PRZM II parameters are in Table 4, and EXAMS parameters in Table 5. Descriptions of special considerations used to select environmental fate parameters or to generate modeling input values are described below.

Vapor Pressure and Henry's Law Constant. The values used as input parameters to EXAMS were not consistent with the value discussed in the RED Chapter (Dye *et al., 1999*). The value used here and in the previous modeling is from the Registration Standard (US EPA, 1988) and believed to be more reliable. The RED Chapter will be revised accordingly.

Hydrolysis. The process specific rate constants (k_{acid}, k_N, k_{alk}) been calculated from the pH specific rate constants at pH's of 5, 7, and 9 and used in EXAMS for KAH, KNH, and KBH respectively.

Soil Metabolism. The aerobic soil metabolism input parameter for PRZM (DWRATE and DSRATE) was estimated from the upper 90% confidence bound on the mean of the half-lives from two studies. The estimated value is 1.687x 10^{-2} d^{-1} corresponding to a half-life 41.1 days. A single anaerobic soil metabolism study was submitted but was conducted by amending with glucose and is thus not suitable for use in simulation modeling. The metabolism rate constant used for sub-surface horizons is equal to the aerobic soil metabolism value divided by two to account for the uncertainty due the use of surrogate data.

Aquatic Metabolism. No aquatic metabolism data was submitted for diazinon. The input parameter for KBACW, the metabolic degradation input parameter for the water column was estimated by dividing the PRZM aerobic input parameter by 2 for a value of 8.435 x 10^{-3} d^{-1}, or 3.514 x 10^{-4} h^{-1}. Similarly, the value for KBACS was generated from the input parameter for the subsurface horizons in PRZM by dividing it by two for a value of 1.757 x 10^{-4} h^{-1}.

Photolysis. Photolysis was not considered in previous modeling. The photolysis rate constant for soil of 8.32 x 10^{-1} d^{-1} was added to the metabolism rate for a layer consisting of the top 0.2 cm of the soil to simulate photolysis in PRZM. In EXAMS, the aqueous photolysis rate was used as the value for KPS.

Foliar Degradation Constants. Foliar dissipation processes need to be considered for crops where diazinon is applied to the plant rather than to the soil. We have found two studies in the open literature for diazinon dissipation from foliage (see Table 3). The rate constant corresponding the upper 90% confidence bound on the mean half-life was used for the foliar dissipation half-life in PRZM. This value was 0.17 d^{-1} or a half-life of 4.0 d. The standard deviation was estimated for this calculation from the weighted variances reported in the studies. Data for the foliar washoff rate was not available so the default value of 0.5 was used.

Soil Water Partition Coefficients. A re-analysis of the soil water partitioning data used to support registration (Guth,1972) does in fact show that the binding is proportional to the organic carbon content with greater than 95% confidence. The R^2 for the correlation was 96%. The estimate of K_{oc} based on linear regression was 758 L kg^{-1}.

Table 3. Environmental fate parameters for diazinon.		
Fate Parameter	Value	Source
Molecular Mass	304.34 g · mol^{-1}	EFGWB One-Liner
Aerobic Soil Metabolism Rate Constant	1.87 x 10^{-2} d^{-1} 1.77 x 10^{-2} d^{-1}	Dye *et al. 1999*
K_{oc}	758 L · (kg-organic carbon)$^{-1}$	Guth, 1972
Solubility	40 mg · L^{-1}	EPA, 1988
Vapor Pressure	1.40 x 10^{-4} torr	EPA, 1988
Henry's Law Constant	1.40 x 10^{-6} atm m^3 mol^{-1}	EFGWB One-liner
pH 5 Hydrolysis Rate Constant	5.78 x 10^{-2} d^{-1}	Dye *et al.*, 1999
pH 7 Hydrolysis Rate Constant	5.02 x 10^{-3} d^{-1}	Dye *et al.*, 1999
pH 9 Hydrolysis Rate Constant	9.00 x 10^{-3} d^{-1}	Dye *et al.*, 1999
Soil Photolysis Rate Constant	8.32 x 10^{-1}	MRID 00153229
Aqueous Photolysis Constant	1.32x10^{-2} d^{-1}	MRID 40863401
Washoff Fraction	0.5 cm^{-1}	default, EFED guidance
Foliar Degradation Rate Constant	3.0 4.0 1.1	Willis *et al.*, 1980

Table 4. PRZM 2.0 input parameters for diazinon.

Input Parameter	Value
Foliar Volatilization (PLVKRT)	0 d^{-1}
Foliar Decay Rate (PLDKRT)	1.75×10^{-1} d^{-1}
Foliar Washoff Extraction Coefficient (FEXTRC)	0.5 cm^{-1}
Plant Uptake Fraction (UPTKF)	0
Organic Carbon-Water Partition Coefficient (SOL)	758 L·(kg-organic carbon)$^{-1}$
Degradation Rate: Photolysis Horizon (DWRATE & DSRATE)	8.49×10^{-1} d^{-1}
Degradate Rate: A Horizon (DWRATE & DSRATE)	1.69×10^{-2} d^{-1}
Degradation Rate: Lower Horizons (DWRATE & DSRATE)	3.44×10^{-3} d^{-1}
Vapor Phase Decay Rate: All Horizons (DGRATE)	0 d^{-1}

Soil Volatilization. The soil volatilization routines in PRZM 2 were deactivated by setting the relevant parameters (vapor diffusion rate, Henry's Law Constant and the enthalpy of vaporization) to zero. The ability to estimate some of the necessary parameters, particularly the enthalpy of vaporization for diazinon, is very poor, and there is there is lack of confidence in the validity of the PRZM 2 volatilization routines as they have not been used frequently.

Table 6. EXAMS 2.97 Input parameters for diazinon.		
Input Parameter	Value	Quality
Aerobic Aqueous Metabolism Constant (KBACW)	$3.51x10^{-4}$ h^{-1}	poor
Sediment Metabolism Constant (KBACS)	$1.76x10^{-4}$ h^{-1}	very poor
Acidic Hydrolysis Rate Constant (KAH)	222 L·(mol-H^{+})$^{-1}$ ·h^{-1}	good
Neutral Hydrolysis Rate Constat (KNH)	$1.85x10^{-4}$ h^{-1}	good
Alkaline Hydrolysis Rate Constant (KBH)	19.0 L·(mol-OH$^{-)}$-1 ·h^{-1}	good
Photolysis Rate Constant (KDP)	$5.50x10^{-4}$ h^{-1}	good
Partition Coefficient (KPS)	758 L ·kg^{-1}	very good
Molecular Mass (MWT)	304.34 g ·mol^{-1}	excellent
Solubility (SOL)	40.0 mg· L^{-1}	good
Vapor Pressure (VAPR)	$1.40x10^{-4}$ torr	good
Q10 For The water Column (QTBAW)	2	poor
Q10 For Sediment (QTBAS)	2	poor

Application Rates and Timing

Application data for each of crop is listed in Tables 7 and 8 . The maximum label application rates are in Table 7 and the typical rates are in Table 8. For the maximum label application, an aerial application was used since this is allowed on the label. However, for the typical application practice, a spray blast application was used as this is the most common application method used on orchard crops. These practices was implemented in the simulation according the the revised draft guidance for drinking water exposure assessments with models (Jones *et al*., 2000). For the aerial applications, 16% of the application rate *to a single acre* is loaded into the reservoir and 95% of the *total application to the watershed* stays on the field and is available for runoff. These values were placed in the DRFT and APPEFF parameters in PRZM respectively. For the typical applications, DRFT was set to 0.063 and APPEFF was set to 0.99. This is to reflect the lower drift fraction and greater application efficiency for spray blast applications. Typical application rates were taken from the Quantitative Usage Analysis ((Halvorson, 1999). The values used represent the mean single application rate and mean number of applications. The mean number of applications was rounded up to the nearest whole number value for use in this assessment.

Table 7. Maximum Label Application Rates for diazinon applied crops in this assessment.				
Crop	Single Application Rate	Date of First Application	Number of Applications	Application Interval
	(lb/acre)			(days)
Oranges	2.0	July 1	2	30
Peaches	2.0	March 10	3	7
Walnuts	3.0	February 1	3	14
* Oranges are being used to represent all citrus crops.				

Application timing was chosen to be representative of agricultural practice in each state. The dates for first application in each year were July 1, March 10, and February 1 for oranges, peaches and walnuts respectively. The application timing for walnuts represents application to dormant trees rather than application during the growing season. Subsequent applications were based on the minimum time between applications allowed on the label for both maximum and typical application practices.

Table 8. Typical Application Rates for diazinon applied crops in this assessment based on Office of Pesticide Programs Quantitative Usage Assessment (Halvorson, 1999).				
Crop	Single Application Rate	First Application Date	Number of Applications	Application Interval
	(lb/acre)			(days)
Oranges*	1.7	July 1	2	30
Peaches	1.9	March 10	2	7
Walnuts	1.7	February 1	2	14
* Oranges are used to represent all citrus crops.				

Procedure

The PRZM 3 simulation was run for a period of 36 years from 1948 to 1983 for both walnuts and oranges and a period of 34 years, 1950 to 1983 for peaches. EXAMS was run in mode 3 for all three scenarios. EXAMS loading (‘P2E-C1’) files were used to transfer the loading information from PRZM to EXAMS. The greatest annual peak, 4, 21, and 60 day means as well as the annual means and overall means were extracted from the REPORT.XMS file using Table20. Only the annual peak, and mean and overall mean are reported here as they are the only values relevant to our current human health risk assessments. The 10 year annual return frequency EEC's (or 10% annual exceedance EEC's) listed in Table 1 were calculated by linear interpolation between the third and fourth largest values by Table 20. The reported values were then multiples by the default percent crop area (PCA) factor of 0.87 in accordance with current guidance (U.S. EPA 2000b). This value represents an upper bound on the total amount of agricultural land that is found in any 8-digit hydrologic unit in the nation. A more complete discussion of the derivation of this value is contained in the documentation and in the discussion below. Input files for these analyses are listed in Appendix E. Assumptions and limitations of this analysis are discussed in the guidance documents for water assessments (United States Environmental Protection Agency, 2000a, 2000b)

Literature Citations

MRID 40512601. Guth, J. 1972. *Adsorption and leaching behavior of diazinon in various soils.*

Aizawa, T. and Y. Magara. 1992. Behaviour of pesticides in drinking water purification systems.Water Analysis, Malaysia, ‘92. cited in Magara *et al.,* 1994. Degradation of Pesticides by Chlorination during Water Purification.*Wat. Sci. Tech.* 30(7):119-128.

Allen, jr, B.W., M. C. Barber, S. L. Bird, L. A. Burns, J. M. Cheplick, M.J. Fendley, D.R. Hartel, C. A. Kittner, F. L. Mayer, jr., L.A. Suarez, and S. E. Wooten. 1992, *PIRANHA: Pesticide and Industrial Chemical Risk Analysis and Hazard Assessment, version 3.0.* Environmental Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Athens, GA.

Burns, Lawrence, 1997. *Exposure Analysis Modeling System (EXAMS II): User’s Guide for Version 2.97.5.* Ecosystem Research Division, National Exposure Research Laboratory. U. S. Environmental Protection Agency, Athens, Georgia.

Carsel, R. F., J. C. Imhoff, P. R. Humel, J. M. Cheplick, and A. S. Donigian, Jr. 1997. *PRZM-3, A Model for Predicting Pesticide and Nitrogen Fate in the Crop Root and Unsaturated Zones:User’s Manual for Release 3.0.* National Exposure Research Laboratory, Office of Research and Development, U. S. Environmental Protection Agency, Athens, GA.

Domagalski, Joseph, 1996. Pesticides and pesticide degradation products in stormwater runoff: Sacramento River Basin, California. *Journal of the American Water Resources Association.* **32**(5):953-954.

Dye, Laura, James Felkel, Gabe Patrick, Robert Matzner, Laura Parsons, and Estella Waldman. 1999. *EFED RED Chapter for Diazinon.* http://www.epa.gov/pesticides/op/diazinon/efedrisk.pdf

Halvorson, Allan. 1999. *Quantitative Usage Analysis for Diazinon.* internal Office of Pesticide Programs document dated January 29, 1999.

Jones, R. David Jones and Sidney Abel. 1997. *Use of a Crop Area Factor in Estimating Surface-Water-Source Drinking Water Exposure.* Presentation to the FIFRA Science Advisory Panel, December, 1997.

Magara, Y., T. Aizawa, N. Matumoto, and F. Souna. 994. Degradation of pesticides by chlorination during water purification, ground water contamination, environmental restoration, and diffuse source pollution. *Wat. Sci. Tech.* 30(7):119-128.

Matzner, Robert. *Water Resources Assessment for Diazinon.* Internal EPA Memorandum to Catherine Eiden dated May 10, 1999.

Ohashi, N., Y. Tsuchida, H. Sasano, and A. Hamada. 1994. Ozonation products of organophosphorous pesticides in water. *Japanese Journal of Toxicology and Health* ***40*** (2):185-192.

Parker, Ronald D., Henry Nelson, R. David Jones and Siroos Mostaghimi. *Guidance of Input Parameters for Tier 2 Modeling.* United States Environmental Protection Agency, Office of Pesticide Programs.

Seaber, Paul R., F. Paul Kapinos, and George L. Knapp. 1987. *Hydrologic Unit Maps.* United States Geological Survey Water-Supply Paper 2294. United States Geological Survey, Denver, Colorado.

United States Department of Agriculture National Resource Conservation Service. 1998. *Official Soil Series Descriptions.* http://www.statlab.iastate.edu/soils/osd/

United States Department of Agriculture National Agricultural Statistics Service. 1999. *1997 Census of Agriculture.* http://www.nass.usda.gov/census/

United States Environmental Protection Agency. 2000a. *Drinking Water Screening Level Assessment, Part A: Guidance for Use of the Index Reservoir in Drinking Water Exposure Assessments.* Office of Pesticide Programs. U. S. Environmental Protection Agency. Public Comment Draft dated September 1, 2000. http://www.epa.gov/pesticides/trac/science/reservoir.pdf

United States Environmental Protection Agency. 2000b. *Drinking Water Screening Level Assessment, Part b: Applying a Per Cent Crop Area Adjustment to Tier 2 Surface Water Model Estimates* *for Drinking Water Exposure Assessments*. Office of Pesticide Programs. U. S. Environmental Protection Agency. Public Comment Draft dated September 1, 2000. http://www.epa.gov/pesticides/trac/science/reservoir.pdf

United States Environmental Protection Agency. 1988. *Guidance for the Reregistration of Pesticide Products Containing Diazinon as the Active Ingredient*. 540/RS-89-016. Environmental Protection Agency, Office of Pesticide Programs, Washington DC.

Willis, G. H., W. F. Spencer, and L. L. McDowell, 1980. The Interception of Applied Pesticides by Foliage and Their Persistence and Washoff Potential. ***In*** *Knisel, Walter G., editor,.CREAMS: A Field Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems*. U. S. Department of Agriculture, Conservation Research Report No. 26, p. 395-606

cc: Ben Chambliss
Jim Felkel
Tom Steeger
chemical file

EEC file
reading file

Appendix A
PRZM 3 Scenario Parameters For A Florida Oranges

Table A-1. PRZM 3 climate and time parameters for an orange grove in Osceola County, Florida.*			
Parameter	Value	Source	Quality
Starting Date**	January 1, 1948		
Ending Date**	December 31, 1983		
Pan Evaporation Factor (PFAC)	0.770	PIC	good
Snowmelt Factor (SFAC)	0.15 cm @ K^{-1}	PIC	good
Minimum Depth of Evaporation (ANETD)	25 cm	PIC	good
Location of the NRCS 24 hour hyetograph (IREG)	3	PRZM3 manual	good
* These values are in the RUN file rather than the INP file.			

Table A-2. PRZM 3 erosion and topographic parameters for an orange grove in Osceola County, Florida.*			
Parameter	Value	Source	Quality
USLE soil erodability factor (USLEK)	0.10	PIC	good
USLE topographic factor (USLELS)	0.13	PIC	good
USLE practice factor (USLEP)	1.00	PIC	good
Area of the field (AFIELD)	172.8 ha	US EPA,2000	NA
Land slope (SLP)	1.00%	PIC	good
Hydraulic length (HL)	600 m	US EPA, 2000	NA

Table A-3. PRZM 3 model state flags for an orange grove in Osceola County, Florida.	
Parameter	Value
Pan Factor Flag (IPEIND)	read temp data from weather file
Erosion model flag (ERFLAG)	MUSS
Chemical Application Model (CAM)	foliar
Bulk Density Flag (BDFLAG)	off
Water Content Flag (THFLAG)	off
Kd Flag (KDFLAG)	on
Drainage model flag (HSWZT)	off
Method of characteristics flag (MOC)	off
Irrigation Flag (IRFLAG)	off
Soil Temperature Flag (ITFLAG)	off
Thermal Conductivity Flag (IDFLAG)	off
Biodegradation Flag (BIOFLAG)	off
Partition Coefficient Model (PCMC)	K_{oc}
Initial Pesticide Concentration Flag (ILP)	off

Table A-4. PRZM 3 crop parameters for an orange grove in Osceola County, Florida.					
Parameter	Value			Source	Quality
Initial Crop (INICRP)	1				
Initial Surface Condition (ISCOND)	1 (fallow)				
Number of Different Crops (NDC)	1				
Number of Cropping Periods (NCPDS)	36				
Parameters For First Crop (ICNCN = 1)					
Maximum rainfall interception storage of crop (CINTP)	0.10 cm			PIC	fair
Maximum Active Root Depth (AMAXDR)	100 cm			PIC	fair
Maximum Canopy Coverage (COVMAX)	80%				
Soil Surface Condition After Harvest (ICNAH)	3 (residue)			PIC	
Date of Crop Emergence (EMD, EMM, IRYEM)	May 11				
Date of Crop Maturity (MAD, MAM, IYRMAT)	July 17				
Date of Crop Harvest (HAD, HAM,IYRHAR)	August 1				
USLEC Factor (USLEC)*	.10			standard	fair
Manning’s N for overland flow (MNGN)*	0.023			standard	fair
Maximum canopy height (HTMAX)	100 cm				
	Fallow	Cropped	Residue		
SCS Curve Number (CN)	94	84	89	PIC	fair
* Manning’s N and USLE C parameters are entered three times (NUSLEC = 3), but all three entries are identical.					

Table A-5. PRZM 3 foliar model parameters for an orange grove in Osceola County, Florida.	
Parameter	Value
Harvest disposition flag (IPSCND)	1

Table A-6. PRZM 3 soil parameters for an orange grove in Osceola County, Florida.

Parameter	Value	Source	Quality
Total Soil Depth (CORED)	100 cm	PIC	good
Number of Horizons (NHORIZ)	4		
First Soil Horizon (HORIZN = 1)			
Horizon Thickness (THKNS)	0.2 cm	PIC	good
Bulk Density (BD)	1.44 g @cm^{-3}	PIC	good
Initial Water Content (THETO)	0.086 cm^3-H_2O @cm^3-soil	PIC	good
Compartment Thickness (DPN)	0.1 cm	PIC	
Field Capacity (THEFC)	0.086 cm^3-H_2O @cm^3-soil	PIC	good
Wilting Point	0.036 cm^3-H_2O @cm^3-soil	PIC	good
Organic Carbon Content	0.58%	PIC	good
Second Soil Horizon (HORIZN = 2)			
Horizon Thickness (THKNS)	9.8 cm	PIC	good
Bulk Density (BD)	1.44 g @cm^{-3}	PIC	good
Initial Water Content (THETO)	0.086 cm^3-H_2O @cm^3-soil	PIC	good
Compartment Thickness (DPN)	0.1 cm	PIC	
Field Capacity (THEFC)	0.086 cm^3-H_2O @cm^3-soil	PIC	good
Wilting Point	0.036 cm^3-H_2O @cm^3-soil	PIC	good
Organic Carbon Content	0.58%	PIC	good
Second Soil Horizon (HORIZN = 3)			
Horizon Thickness (THKNS)	10 cm	PIC	good
Bulk Density (BD)	1.44 g @cm^{-3}	PIC	good
Initial Water Content (THETO)	0.086 cm^3-H_2O @cm^3-soil	PIC	good
Compartment Thickness (DPN)	1 cm	PIC	
Field Capacity (THEFC)	0.086 cm^3-H_2O @cm^3-soil	PIC	good

Wilting Point	0.036 cm^3-H_2O @cm^3-soil	PIC	good
Organic Carbon Content	0.58%	PIC	good
Third Soil Horizon (HORIZN = 4)			
Horizon Thickness (THKNS)	80 cm	PICc	good
Bulk Density (BD)	1.58 g @cm^{-3}	PIC	good
Initial Water Content (THETO)	0.030 cm^3-H_2O @cm^3-soil	PIC	good
Compartment Thickness (DPN)	5 cm	PIC	
Field Capacity (THEFC)	0.030 cm^3-H_2O @cm^3-soil	PIC	good
Wilting Point	0.023 cm^3-H_2O @cm^3-soil	PIC	good
Organic Carbon Content	0.116%	PIC	good

Appendix B
PRZM 3 Scenario Parameters For Peaches in Peach County, Georgia

Table B-1. PRZM 3 climate and time parameters for a peach orchard in Peach County, Georgia.[*]

Parameter	Value	Source	Quality
Starting Date[**]	January 1, 1950		
Ending Date[**]	December 31, 1983		
Pan Evaporation Factor (PFAC)	0.75	PIC	good
Snowmelt Factor (SFAC)	0.15 cm @K^{-1}	PIC	good
Minimum Depth of Evaporation (ANETD)	17 cm	PIC	good
Location of the NRCS 24 hour hyetograph (IREG)	2	PRZM 3 Manual	good

* Monthly daylight hours (DT) are in Table A-2.
** These values are in the RUN file rather than the INP file.

Table B-2. PRZM 3 erosion and topographic parameters for an peach orchard in Peach County, Georgia.

Parameter	Value	Source	Quality
USLE soil erodability factor (USLEK)	0.19	PIC	good
USLE topographic factor (USLELS)	3.30	PIC	good
USLE practice factor (USLEP)	1.00	PIC	good
Area of the field (AFIELD)	172.8 ha	US EPA,2000	NA
Land slope (SLP)	4.00%	PIC	good
Hydraulic length (HL)	600 m	US EPA, 2000	NA

Table B-3. PRZM 3 model state flags for a peach orchard in Peach County, Georgia.

Parameter	Value
Pan Factor Flag (IPEIND)	Use monthly values
Erosion Model Flag (ERFLAG)	MUSS
Foliar Application Model Flag FAM)	foliar
Bulk Density Flag (BDFLAG)	off
Water Content Flag (THFLAG)	off
Kd Flag (KDFLAG)	On
Drainage model flag (HSWZT)	off
Method of characteristics flag (MOC)	off
Irrigation Flag (IRFLAG)	off
Soil Temperature Flag (ITFLAG)	off
Thermal Conductivity Flag (IDFLAG)	off
Biodegradation Flag (BIOFLAG)	off
Partition Coefficient Model (PCMC)	K_{oc} model
Initial Pesticide Concentration Flag (ILP)	off

Table B-4. PRZM 3 monthly daylight hours (DT) for a peach orchard in Peach County, Georgia.

Month	Value
January	10.3 h
February	11.0 h
March	12.0 h
April	13.1 h
May	13.9 h
June	14.3 h
July	14.2 h
August	13.4 h
September	12.4 h
October	11.3 h
November	10.5 h
December	10.0 h
Source	PRZM 2 Manual, p 5-28, interpolated for 46B N Latitude.
Quality	good

Table B-5. PRZM 3 crop parameters for a peach orchard in Peach County, Georgia.

Parameter	Value			Source	Quality
Initial Crop (INICRP)	1				
Initial Surface Condition (ISCOND)	1				
Number of Different Crops (NDC)	1				
Number of Cropping Periods (NCPDS)	34				
Parameters For First Crop (ICNCN = 1)					
Maximum rainfall interception storage of crop (CINTP)	0.19 cm			PIC*	good
Maximum Active Root Depth (AMAXDR)	17 cm			PIC*	good
Maximum Canopy Coverage (COVMAX)	100%			**	good
Soil surface condition after harvest (ICNAH)	2 (cropping)				
Date of Crop Emergence (EMD, EMM, IRYEM)	April 1				
Date of Crop Maturity (MAD, MAM, IYRMAT)	May 15				
Date of Crop Harvest (HAD, HAM,IYRHAR)	December 31				
Maximum canopy height (HTMAX)	100 cm			**	
	Fallow	Cropped	Residue		
SCS Curve Number (CN)***	94	78	78	PRZM 3 Manual	fair
USLE C Factor (USLEC)	0.74	0.01	0.01	PRZM 3 Manual	fair
Manning's N for oveland flow (MNGN)	0.03	0.03	0.03		

* Values selected for MLRA A2, grass, pasture, and hay.
** selected as the best value by the judgement of the author.
***selected for meadow, for fallow and meadow, hydrologic group D
‡ Values selected represent fallow for fallow period and meadow for cropped and residue periods.

Table B-6. PRZM 3 foliar model parameters for a peach orchard in Peach County, Georgia.	
Parameter	Value
Harvest disposition flag (IPSCND)	1 (cropped)

Table B-7. PRZM 3 soil parameters for a peach orchard in Peach County Georgia*.		
Parameter	Value	Quality
Total Soil Depth (CORED)	100 cm	good
Number of Horizons (NHORIZ)	3	poor
First Soil Horizon (HORIZN = 1)		
Horizon Thickness (THKNS)	0.2 cm	good
Bulk Density (BD)	1.70 $g \cdot cm^{-3}$	good
Initial Water Content (THETO)	0.213 cm^{3}-$H_2O \cdot cm^{3}$-soil	good
Compartment Thickness (DPN)	0.1 cm	
Field Capacity (THEFC)	0.213 cm^{3}-$H_2O \cdot cm^{3}$-soil	good
Wilting Point	0.063 cm^{3}-$H_2O \cdot cm^{3}$-soil	good
Organic Carbon Content	2.32 %	good
Second Soil Horizon (HORIZN = 2)		
Horizon Thickness (THKNS)	11.8 cm	good
Bulk Density (BD)	1.70 $g \cdot cm^{-3}$	good
Initial Water Content (THETO)	0.213 cm^{3}-$H_2O \cdot cm^{3}$-soil	good
Compartment Thickness (DPN)	0.1 cm	
Field Capacity (THEFC)	0.213 cm^{3}-$H_2O \cdot cm^{3}$-soil	good
Wilting Point	0.063 cm^{3}-$H_2O \cdot cm^{3}$-soil	good
Organic Carbon Content	2.32 %	good
Third Soil Horizon (HORIZN = 3)		
Horizon Thickness (THKNS)	88 cm	poor

Bulk Density (BD)	1.7 g @cm^{-3}	good
Initial Water Content (THETO)	0.354 cm^3-H_2O @cm^3-soil	good
Compartment Thickness (DPN)	2 cm	
Field Capacity (THEFC)	0.354 cm^3-H_2O @cm^3-soil	good
Wilting Point	0.213 cm^{3-}H_2O @cm^3-soil	good
Organic Carbon Content	0.29%	good

Appendix C
PRZM 3 Scenario Parameters For Walnuts in Kern County, California

Table C-1. PRZM 3 climate and time parameters for a walnut grove in Kern County, California.

Parameter	Value	Source	Quality
Starting Date*	January 1, 1948		
Ending Date*	December 31, 1983		
Pan Evaporation Factor (PFAC)	0.852	PIC	good
Snowmelt Factor (SFAC)	0.45 $cm \cdot K^{-1}$	PIC	good
Minimum Depth of Evaporation (ANETD)	20 cm	PIC	good
Location of the NRCS 24 hour hyetograph (IREG)	1	PRZM 3 Manual	good

* These values are in the RUN file rather than the INP file.

Table C-2. PRZM 3 erosion and topographic parameters for an walnut grove in Kern County, California

Parameter	Value	Source	Quality
USLE soil erodability factor (USLEK)	0.16	PIC	good
USLE topographic factor (USLELS)	0.01	PIC	good
USLE practice factor (USLEP)	0.1	PIC	good
Area of the field (AFIELD)	172.8 ha	US EPA,2000	NA
Land slope (SLP)	4.00%	PIC	good
Hydraulic length (HL)	600 m	US EPA, 2000	NA

Table C-3. PRZM 3 model state flags for a walnut grove in Kern County, California.

Parameter	Value
Pan Factor Flag (IPEIND)	2
Erosion Model Flag (ERFLAG)	MUSS
Chemical Application Model Flag FAM)	foliar
Bulk Density Flag (BDFLAG)	off
Water Content Flag (THFLAG)	off
Kd Flag (KDFLAG)	on
Drainage model flag (HSWZT)	off
Method of characteristics flag (MOC)	off
Irrigation Flag (IRFLAG)	off
Soil Temperature Flag (ITFLAG)	off
Thermal Conductivity Flag (IDFLAG)	off
Biodegradation Flag (BIOFLAG)	off
Partition Coefficient Model (PCMC)	K_{oc} model
Initial Pesticide Concentration Flag (ILP)	off

Table C-4. PRZM 3 crop parameters for a walnut grove in Kern County, California.

Parameter	Value			Source	Quality
Initial Crop (INICRP)	1				
Initial Surface Condition (ISCOND)	3 (residue)				
Number of Different Crops (NDC)	1				
Number of Cropping Periods (NCPDS)	36				
Parameters For First Crop (ICNCN = 1)					
Maximum rainfall interception storage of crop (CINTP)	0.30 cm			PIC*	good
Maximum Active Root Depth (AMAXDR)	60 cm			PIC*	good
Maximum Canopy Coverage (COVMAX)	90%			**	good
Soil surface condition after harvest (ICNAH)	2 (cropping)				
Date of Crop Emergence (EMD, EMM, IRYEM)	January 15				
Date of Crop Maturity (MAD, MAM, IYRMAT)	May 15				
Date of Crop Harvest (HAD, HAM, IYRHAR)	December 15				
Maximum canopy height (HTMAX)	1500 cm			**	
	Fallow	Cropped	Residue		
SCS Curve Number (CN)	86	78	92		fair
USLE C Factor (USLEC)	0.74	0.01	0.01	PRZM 2 Manual‡	fair
Manning's N for overland flow (MNGN)	0.02	0.02	0.02		

* Values selected for MLRA A2, grass, pasture, and hay.
** selected as the best value by the judgement of the author.
‡ Values selected represent fallow for fallow period and meadow for cropped and residue periods.

Table C-5. PRZM 2 foliar model parameters for a walnut grove in Kern County, California.

Parameter	Value
Harvest disposition flag (IPSCND)	1 (cropped)

Table C-6. PRZM 3 soil parameters for a walnut grove in Kern County, California.

Parameter	Value	Quality
Total Soil Depth (CORED)	125 cm	good
Number of Horizons (NHORIZ)	4	poor
First Soil Horizon (HORIZN = 1)		
Horizon Thickness (THKNS)	0.2 cm	good
Bulk Density (BD)	1.45 $g \cdot cm^{-3}$	good
Initial Water Content (THETO)	0.212 cm^3-$H_2O \cdot cm^3$-soil	good
Compartment Thickness (DPN)	0.1 cm	
Field Capacity (THEFC)	0.212 cm^3-$H_2O \cdot cm^3$-soil	good
Wilting Point	0.0073 cm^3-$H_2O \cdot cm^3$-soil	good
Organic Carbon Content	0.8 %	good
Second Soil Horizon (HORIZN = 2)		
Horizon Thickness (THKNS)	4.8 cm	good
Bulk Density (BD)	1.45 $g \cdot cm^{-3}$	good
Initial Water Content (THETO)	0.212 cm^3-$H_2O \cdot cm^3$-soil	good
Compartment Thickness (DPN)	0.1 cm	
Field Capacity (THEFC)	0.212 cm^3-$H_2O \cdot cm^3$-soil	good
Wilting Point	0.0073 cm^3-$H_2O \cdot cm^3$-soil	good
Organic Carbon Content	0.8 %	good
Third Soil Horizon (HORIZN = 3)		
Horizon Thickness (THKNS)	20 cm	good
Bulk Density (BD)	1.45 $g \cdot cm^{-3}$	good
Initial Water Content (THETO)	0.212 cm^3-$H_2O \cdot cm^3$-soil	good
Compartment Thickness (DPN)	5 cm	
Field Capacity (THEFC)	0.212 cm^3-$H_2O \cdot cm^3$-soil	good
Wilting Point	0.0073 cm^3-$H_2O \cdot cm^3$-soil	good
Organic Carbon Content	0.8 %	good

Fourth Soil Horizon (HORIZN = 4)		
Horizon Thickness (THKNS)	100 cm	poor
Bulk Density (BD)	1.65 g $\cdot cm^{-3}$	good
Initial Water Content (THETO)	0.202 cm^3-H_2O $\cdot cm^3$-soil	good
Compartment Thickness (DPN)	5 cm	
Field Capacity (THEFC)	0.202 cm^3-H_2O $\cdot cm^3$-soil	good
Wilting Point	0.0962 $cm^{3-}H_2O$ $\cdot cm^3$-soil	good
Organic Carbon Content	0.29%	good

Appendix D
Temperature Profiles For Index Reservoirs

Table D-1. EXAMS mean monthly water temperatures for the Index Reservoir in Kern County, California.

Month	Temperature (Celsius)
January	8.83
February	11.74
March	13.84
April	17.11
May	21.45
June	25.73
July	29.08
August	27.98
September	25.19
October	19.88
November	13.56
December	9.03

Table D-1. EXAMS mean monthly water temperatures for the Index Reservoir in Peach County, Georgia.

Month	Temperature (Celsius)
January	7.19
February	8.75
March	12.60
April	17.20
May	21.67
June	25.33
July	27.03
August	26.56
September	23.51
October	17.52
November	12.11
December	8.17

Appendix E
Input File Names

Table C-1. Input files archived for diazinon applied to pome fruits.

File Name	Date	Description
MET17.MET	August 11, 1992	MRLA C17 weather data
MET137.MET	March 22, 1991	MLRA 137 weather data
MET156a.MET	August 13, 1992	MLRA R156a weather data
GAPchIR.EXV	November 7, 2000	Index Reservoir for the peach scenario
IRCAWnut.EXV	November 6, 2000	Index Reservoir for the walnut scenario
IRFLCit.EXV	February 3, 2000	Index Resevoir for Florida orange scenario.
DIAZ2.EXC	November 7, 2000	diazinon chemistry data for EXAMS
Input Data File Sets*		
OR156IR1	INP: November 7, 2000 RUN: November6, 2000	File set for diazinon maximum application on oranges
OR156IR2	INP: November 7, 2000 RUN: November 13, 2000	File set for typical diazinon application to oranges
PH133IR1	INP: November 13, 2000 RUN: November 6, 2000	File set for maximum diazinon application to peaches
PH133IR2	INP: November 14, 2000 RUN: November 6, 2000	File set for typical diazinon application to peaches
WN17IR00	INP: November 13, 2000 RUN: November 6, 2000	File set for maximum diazinon application to walnuts
WN17IR01	INP: November 13, 2000 RUN: November 6, 2000	Files set for typical diazinon application to walnuts

* File sets consist of a PRZM 3 input (INP) file, and a PRZM 3 run (RUN) file.